**The University of New Mexico**

**School of Engineering**

**Electrical and Computer Engineering Department**

**ECE 535 Satellite Communications**

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Module # 14: Problems 14.1, 14.2, 14.3, 14.4, 14.6, 14.7, 14.8

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14.1. Explain what is meant by a single access in relation to a satellite communications network. Give an example of the type of traffic route where single access would be used.

Single access in satellite communications means that one earth station uses the entire transponder on the satellite without sharing it with others. There’s no competition for bandwidth or power, so you get the full capacity. This setup is useful when a consistent, high-quality connection is needed. A good example would be a dedicated link between two major cities, like New York and London, where there's a constant flow of high-volume data, voice, or video traffic that justifies having a transponder all to itself.

14.2. Distinguish between preassigned and demand-assigned traffic in relation to a satellite communications network.

In a satellite communications network, preassigned traffic refers to bandwidth or channels that are permanently allocated to specific users or routes. These don’t change, even if the capacity isn’t being used all the time. On the other hand, demand-assigned traffic is more flexible. Bandwidth is allocated only when it’s needed, based on real-time demand. This helps make better use of satellite resources, especially when traffic patterns are unpredictable or vary throughout the day. Demand-assigned access is common in systems where users connect only occasionally, like mobile terminals or small VSAT networks.

14.3. Explain what is meant by FDMA, and show how this differs from FDM.

FDMA stands for Frequency Division Multiple Access. It’s a method used in satellite communications where multiple users share a transponder by being assigned separate frequency bands. The “multiple access” part means many users can use the satellite at the same time without interfering with each other. FDM, or Frequency Division Multiplexing, is a little different. It combines multiple signals into a single stream before it’s sent over one channel. While FDM is about combining signals at one source, FDMA is about letting multiple users independently access a shared satellite transponder using different frequencies.

14.4. Explain what the abbreviation SCPC stands for. Explain in detail the operation of a preassigned SCPC network.

SCPC stands for Single Channel Per Carrier. It’s a method used in satellite communications where each voice, data, or video channel is transmitted on its own dedicated carrier frequency. In a preassigned SCPC network, each earth station is given a fixed carrier frequency and bandwidth ahead of time. These assignments don’t change, they’re always available to the station whether the channel is in use or not. This setup is simple and reliable, and it’s often used on point-to-point links where traffic is steady and predictable. The downside is that it’s not very efficient if traffic is bursty or varies a lot, since unused capacity just sits idle when a channel isn't active.

14.6. Briefly describe the ways in which demand assignment may be carried out in an FDMA network.

In an FDMA network, demand assignment can be done in a few different ways. One common method is frequency hopping, where users are temporarily assigned different frequency slots as needed. Another approach is to assign frequencies dynamically from a shared pool whenever a user requests access. Some systems also use time-limited assignments, where a frequency is granted for a set period and then released back into the pool. These strategies help make better use of bandwidth by only assigning resources when there’s actual demand, rather than keeping them tied up all the time.

14.7. Explain in detail the operation of the Spade system of demand assignment. What is the function of the common signaling channel?

The SPADE system is an early form of demand-assigned FDMA. In this system, voice or data channels are assigned on demand using SCPC carriers. When a user wants to initiate a call, the request goes through a common signaling channel, which is a dedicated frequency used by all earth stations to coordinate communication. This channel handles call setup, teardown, and channel assignment, kind of like a traffic cop directing users to an available lane. Once a call is set up, the system assigns a free frequency slot from a shared pool, and the call proceeds on that frequency. After the call ends, the frequency returns to the pool for someone else to use. This approach makes efficient use of satellite bandwidth by only using channels when they’re needed.

14.8. Explain what is meant by power-limited and bandwidth-limited operation as applied to an FDMA network. In an FDMA scheme the carriers utilize equal powers and equal bandwidths, the bandwidth in each case being 5 MHz. The transponder bandwidth is 36 MHz. The saturation EIRP for the downlink is 34 dBW, and an output backoff of 6 dB is employed. The downlink losses are 201 dB, and the destination earth station has a G/T ratio of 35 dBK1 . Determine the [C/N] value assuming this is set by single carrier operation. Determine also the number of carriers which can access the system, and state, with reasons, whether the system is power limited or bandwidth limited.

In an FDMA network, power-limited operation means the system can’t support more users because the total available transmitter power is already used up even if there’s still bandwidth left. On the other hand, bandwidth-limited means the system runs out of available spectrum before it runs out of power. So, the limiting factor is either how much spectrum you can divide or how much power you can allocate without degrading signal quality.